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ABSTRACT

This paper discusses problems with the theoretical basis and conditions for implementing the quality insurance model for engineering programs. An analysis of a program of development and educational quality implemented in the Engineering Faculty of the National University of Lomas de Zamora in Argentina is presented. The minimum conditions are discussed that a program of insurance, evaluation, and university improvement should complete in order to guarantee their effectiveness. (WRM)

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ANALYSIS OF A QUALITY PROGRAM IN THE FORMATION OF ENGINEERS BASED ON THE ISO NORM 9000 MODEL

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Abstract

Exist wide evidences of the necessity of programs of evaluation, insurance and improvement of the University Engineering Education.

In this work some difficulties of theoretical frame are analyzed and of practical implementation that some models and programs of insurance of the quality present for the teaching of engineering. The minimum conditions are discussed that a program of insurance, evaluation and university improvement should complete in order to guarantee their effectiveness.

The above-mentioned arises from the analysis of a Program of development and insurance of the quality of the teaching implemented in the Faculty of Engineering of the University of Lomas de Zamora from Argentina. Statement programs has been model starting from the ISO norms 9000. It is described and analyze the type of academic unit, the determinants of their institutional objectives of quality, and the constitution of a committee of quality. In particular the impact in the institutional development of the executed actions is studied that they assure the quality of the system regarding: Commitment with the quality and involve of the mannagement university; control of the Design and conditions for the bringing up to curricular date of plans of study, control of processes in the formation of engineers through the development of projects of classes, control of Not Conformities and Correctives Actions for the improvement of the teaching, training of educational human resources in function of the Quality System. Lastly the validity of a model is evaluated based on ISO Norms 9000 to the effects of implementing procedue of guarantee of quality in the context of the Faculties and Schools of formation of engineers.

Introduction

The Institution of engineering teaching must generate knowledge, validate it and assure its transfer as a social asset. That is to say to investigate and to teach in a setting of quality guarantee for the interested community.

Considering this demand faculties and schools of engineering develop strategies and programs in order to evaluate and assure the quality level of their services.

Now we analyse some difficulties of theoretical base and of implementation conditions that the quality insurance model presents for the teaching of engineering.

We analyze a Program of development and insurance of the educational quality implemented in the Engineering Faculty of the National University of Lomas de Zamora in Argentina. This program has been modeled following a system based on the ISO Norm 9000.

We analyze the type of academic unit and its determinants. We indicate the impact the actions that assure the quality of the system in the institutional development have regarding:

Commitment with the educational quality.

Control of the Design for bringing up to date curriculum.

Control of Processes of formation of engineers by means of investigation and class projects.

We consider the validity of a model based on ISO 9000 in order to guarantee the quality in the Faculty and Schools of Engineers context.

University and Quality

Much evidence of the necessity exists of guaranteeing the Quality in the University Education of Engineering, carrying out programs of evaluation, insurance and improvement of its quality.

This necessity is urgent in face of the crisis that suffers the model of university teaching of engineering in Argentina at present.

We begin by considering as a fundamental task of a university, the investigation and teaching to the highest level. This is achieved only if the university is becoming by its scientific effort and the quality of its service, in the point

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Therefore, the institutions of engineering teaching obey to a social command: generate knowledge, validate it and assure its transfer as a social asset; that is to say, investigate, meditate epistemologically and teach in a way to guarantee its quality in face of the interested community.

The aforementioned indicates that both the scientific attitude and the guarantee of quality belongs naturally to the university life. So that the scientific and technological investigation and the quality in teaching concerns intrinsically to the university centers of engineering. In other words the quality conditions the competition and scientific and technological effectiveness of a Faculty or engineering School.

Then, because of the nature of its speciality, the teaching of engineering is neither an object easily analyzable nor modeling. It is not experimentally out of context. On the contrary the teaching of engineering constitutes a complex, organic, systemic and continually changeable element.

Having this in mind, it has been developed a varied set of projects, strategies, procedures and programs in order to study, evaluate and assure the quality in the university formation of engineers.

But in such programs it stands out first by the diversity and difficulty of the theoretical setting and the problems of practical implementation more than the results that such programs present. This makes it necessary to discuss the minimum conditions that the programs of evaluation, of improvement and they of quality insurance should fullfill in order to guarantee their effectiveness in the university context. Discussing such conditions implies at least to describe, to analyze and to differentiate such elements in the University like:

Type of academic unit,
Institutional objectives,
Contexts of population and budget,
Quality and Community commitments,
Constitution of evaluation and quality groups,
Analysis and action criteria on the decisive variables,
Impact in the Institution and the Community of quality and improvement policies.

But in practice this task always remains subject to cultural, political and budgetary conditions, therefore it must be developed strategies of validity, pursuit and control that minimized such difficulties.

As regards this it has been understood that the University is an a organization that supplies a special service of high incidence in the social results which it influences on. Therefore is of interest to assure the conditions under which it could carry out its tasks of investigation and teaching with high degree of excellence and assisting to the requirements of forming competent engineers for the professional demands.

With this premise, we approach the study of the case of the Lomas de Zamora Engineering Faculty (FIUNLZ) in Argentina, as a leading study of the problems of quality insurance in the formation of national level engineers, believing it is a case that it can be extrapolated to other Latin America contexts.

Presentation of the FIUNLZ case

The FIUNLZ was created in 1983 in the center of the urban conglomerate south of Great Buenos Aires, with more than 2,000,000 inhabitants. It assists necessities of professional formation of engineering for an industrial park of more than 4000 companies of distinct types. Today these companies are growing because of the expansion that brought about Mercosur to the regional dynamics and therefore they are strong consumers of professional technologists.

It possesses a constant population of approximately 1000 students and an educational staff of 180 professionals and professors.

Its brief history is bound to the changes and transformations that it has suffered the Argentine society and particularly to the educational transformation that legislation has designed (Federal Education and High Level Education laws).

Therefore, since its foundation, the FIUNLZ had to adapt itself continually to changing stages motivated by:

The technological trasformations of the end of the century.

The economic social changes of the Country and the Region.

The new demands of the market, the legislation, and the professional formation of engineers.

Diverse roads have been rehearsed in order to guarantee the quality of the teaching in such context of continuous change.

As a result two parallel strategies have been designed, that is:

1.- To develop a new Curricular Design, making the plans of study flexible and generating conditions for their revision and continuous validity.

2.- To implement a program to insure the educational quality having as a model the ISO norm 9000 paradigm.

The objective of this double strategy is to reach a state of maturity in the Organization so as to enable the formation of engineers in the XXI century with quality and technological actualization guarantee.

Quality, University and ISO Norms 9000

It is important to note that the relevance and convenience of adopting models of Quality Management, that appear more characteristic of managing organizations that of academic life, was subject of deep analysis and evaluation between the personnel actors of the FIUNLZ.

As a result it was decided to adopt the TQM tool for the institutional improvement, and the ISO series 9000 normative for the insurance of its quality system, based mainly in the fact that the Faculty of engineering has an insertion and a first and very strong ownership with the productive managing system. So that its impronte as an organization strikes more directly in the managing environment than in the academic one. With this definition we aim to perfect a model of university committed with the transfer of knowledge to the social environment since this is a little developed imperative in our countries.

Here we will define Quality as the group of aspects and characteristics of a product, process or service, related with their aptitude in order to satisfy the established or implicit necessities.

The Universities can be considered like organizations whose purpose is the production and the service of transfer of a very special characteristic product to called Knowledge. In the university can be obtained the processes of search of knowledge and service of transmission for teaching and learning.

Consequently the University is a supplier that assists the requirements of at least three types of clients or adopters:

1.- The student as a requirer of knowledge and professional formation (whom we will denominate 1st. Level adopter)

2.- The productive and social community as a requirer of knowledge and of professionals (2nd. Level adopter)

3.- The scientific community as a recipient of the activities of investigation (3rd. Level adopter)

Following this reasoning it results that the product of the University is a complex product that is able to segregate in three instances:

1.- the technological knowledge obtained by investigation (1st. Instance)

2.- the opportunity of learning through teaching (2nd. Instance)

3.- the graduate professional as adopter of such systematized knowledge (3rd. Instance)

So that to understand the concept of quality in the university we begin with its definition as the capacity to organize the answers and to give satisfactory execution in all instances to the requirements of its adopters in all levels.

However, it seems evident that Quality appears here as a multidimensional concept and depending to a great extend on the components and functions from the university system which it qualifies to. In fact, on applying the Quality concept to the High Level Education a double dimension of the quality concept appears:

1.- an intrinsic quality (investigation and production of knowledge capacity), and

2.- an extrinsic quality (transfer of the knowledge by teaching or application capacity).

The intrinsic dimension of the university quality is related to the fulfillment of the aims of the disciplinary knowledge development through the integrated plans or projects of investigation and knowledge application required by the society or by the scientific community of reference (technological innovations in the case of the engineerings).

The extrinsic dimension of the university quality is related to the responsible fullfillment of the transference goals to different adopters (the students that adopt the plans of study and courses, the emploeers that adopt the graduates, the community that entrusts developments and specific trainings).

All the aforementioned said shows the difficulty of a definition and an accurate dimension of what we call quality in the university education.

For this reason, in the FIUNLZ case that we analyze here, it was made clear that the support of the university institution quality should be founded on its own system of operation. That is to say, in the own organic structure of the Faculty as condition of possibility for the quality of the execution of their intrinsic or extrinsic functions. The own school system should be designed as a quality system. It is here where the paradigm of the quality systems as that of TQM or that of the ISO 9000 normative, developed originally for companies, acquires a fundamental importance in order to illuminate the evolution of the high level educational systems.

We will concentrate now in the perspective that implies to develop a quality system based on ISO 9000 in the Faculty of engineering context.

It is obvious that before any another consideration, leaders of the faculty were interested in developing the quality system as a competitive strategy in order to grow in more and more demanding educational market, more unruled and more globalized.

As a starting point and in order to design the quality system it was kept in mind the productivity indicators or the faculty academic performance. These indicators evidence a mixture of weakness and strengths of different production if they are compared with the national or international standards.

So the Faculty evidence as central weaknesses:

1.- low production of graduation by enters.

2.- lengthening of the time for getting the degree.

3.- scarce development of the human resources dedicated to investigation.

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To balance this, the Faculty possesses evident strengths in:

1.- labor insert of the graduates in their own specialty and in managing posts.

2.- sustained demand of the industrial local means for the provision of services and transfers

3.- educational professionals with great experience and acting in companies of first level in the country.

For all this the quality system is born as the determination of the Faculty Head office to transform the institution profile, improving its benefit and competitiveness and assuring the quality of its results. That is to say, it is born as the implementation of a system that simply assures the support of the strengths that allow to improve the weakness.

Therefore the establishment of a quality system in the educational institution is an opportunity to optimize the available resources and processes assuring the execution of the planed objectives and getting the satisfaction of the requirers.

Implementing a quality system implies in the first place to revise the whole cycle of the organization. From the relationship with the market requeriments of adopters, through the process of design of the plan of the teaching service, through the processes of production of the learning results, the investigation or the required transfer and then always returning to the adopters in order to evaluate their satisfaction on what was given to them.

Likewise a quality system implies the essentially necessity of establishing sound procedures of how the processes are carried out. This is needed to monitor their execution and their consistency, and in order to give the adopter the necessary trust to adopt the service.

Also, and as a fundamental piece of a quality system developed for the education, the system should articulate with the systematic training and qualification of the whole involved personnel (not only educational but also non educational sataff). Qualification for the exercise of investigation or teaching based on the deviced procedures, and by virtue of the evidence of the necessary abilities for the objective execution of their responsibilities.

Structure of the Quality System

Having taken into account the more generals considerations that justify the implementation of a quality program based on ISO Norms 9000 applied to the formation of engineers, we come to analyze now the most relevant characteristics of the system.

All quality system based on ISO 9000 has a complex and consistent architecture of requirements.

In between all the requirements, we separate those that can be considered keys or structuring of the system for their analysis and then we consider them having in mind the implementation in the FIUNLZ.

We can state that the keys of a quality system are:

1.- The directive commitment

2.- The necessities of the clients and the design of the benefits or services

3.- The administration of the processes

4.- The auditings

5.- The motivation, training and qualification of the personnel

About each one of these keys will shortly say:

1.- The Direction commitment expresses itself as a commitment and involvement of the university managers and leaders with quality. It is developed by means of the emission of a quality policy that implies specific objectives. It is got by means of the assignment of resources, the making known, the management and the control of the system.

2.- The determination of the necessities and the design of the services, implies to define the requirements of the social demand exactly as regards the profile of the engineerings and to specify and document the characteristics and the validity of the educational and formative product to be given.

3.- The administration of processes refers to the definition of all the steps that lead to obtain a result, defining, executing and controlling each stage or subprocess. That is to say the own process of teaching in all of its scopes.

4.- The auditings have the purpose of verifying the system consistency and of detecting anomalies and non conformities to indicate their correction.

5.- The motivation, training and qualification of the personnel implies the guarantee of the involved actors fitness, their bringing up to date and continuous improvement and their consent towards the quality and improvement policy.

Description of the quality system

It should be considered that the adoption of an educational program based on ISO Norms 9000 model implies at first to be faithful to the Norm satatements and then to adapt it to the characteristics and codes of an educational organization. If the twenty 9001 norm elements are considered, is strange in the first moment the terminology to be applied. However, it immediately comes out the Norm versatility when its extension is demonstrated. So that you can say that it exists a correlation in the educational organism for all the elements of the Norm.

Let's enter now in the intimacy of the FIUNLZ quality system analyzing as a pattern three of the basic elements, taken from the above done selection.

1.- The commitment with quality and involvement by the university leader.

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This basically implies the existence of an apparent institutional will towards the development of an academic policy found in the quality principles. This will holds it the Academic Council in its character of government maximum organ. It is the one that determines the Institutional Objectives for every academic term and therefore it is the one that decides the priorities for the quality objectives.

Since it is a collegiate body, it was necessary a stage for its becoming aware of the decision about the quality system and of the execution opportunity. This becoming aware reassures the quality institutional.

Consequently by exercising the maximum direction delegates responsibilities and grants resources in order to reach the objectives that determines. Particularly the Academic Council delegates the executive responsibilities of the system in the Dean and in its group of Secretaries.

It also delegates in the Quality Committee responsibilities of elaboration and of monitoring of the system elements. But in both cases it has the control and the final revision.

We will say that the mentioned Quality Committee is a technical organ whose purpose is to design some of the system components and to evaluate and to control statistically its performance, producing pertinent information for the rational taking of the management decisions.

2.- The control of the design and the conditions for the bringing up to date curricula and of plans of study.

This section of the system refers to the determination of the necessities and the design of the services.

In this point it appears a definition that says that the standard outstanding for the faculty is the 9001 Norm. Because it is an organization that designs, projects and specifieas entirely its investigation and teaching actions.

The faculty establishes the procedures in order to detect the necessities of access to the knowledge of the engineering disciplines of their current and potentials adopters in any of the levels already enunciated.

Minding such considerations, all the activities of investigation and of educational transfer that the faculty gives are designed, projected and specified.

The procedures are settled in order to plan the own design activity, naming responsible people, determining entering data, monitoring the whole process of design, presenting and approving the final specification obtained for each design and validating the result of the design with the own adopters.

Several levels of "design products" have been established. They are competition of the faculty and they are linked to the instances descripted above.

The plan of studies of each engineering specialty, the curricular alignment, the projects of each class teaching, the investigation projects of the groups of investigators, are all resultants of an activity of surveying and planned design that constitute the center of the university life.

At this point the two already enunciated strategies the faculty has adopted converge, in order to face the technological challenges of the market of the end of the century. Such strategies are: a) curricular change or redesign, and b) program of quality insurance.

Now it is understood how the quality system includes all the innovative actions executed in order to assist the requirements of change of the engineering education in the beginning of the XXI century.

The own system incorporates the transparent mechanisms for itsr bringing up to date and the redesigns of its validity in time.

The own plan of studies, the curricular approach and the investigation projects and of class teaching, constitute an architecture procedured in such a way that its revision and modification are guaranteed in order to assure its competence in view of the demands of all the potential levels of adopters.

3.- The control of processes.

Refers to the definition of all the steps that lead to obtain a result, defining, executing and controlling each stage or subprocess. That is to say the own process of teaching in all its scopes.

It is the component of the system the one that is in charge of the control of the engineers formation process through the development of chatedra projects, and of plans or projects of investigation and transfer.

For this area the specification of the "product" is considered to be defined by the own plan of study and for the cathedra projects, that must complete a set of requirements and quantifying indicatives that allow monitoring the degree of their execution.

Here comes the planning, execution, control, and correction of the whole process of engineering formation. It ranges from the student admission, through all the academic cycles, up to his graduation and leaving as a "finished product" with the corresponding professionals qualifications and competitions.

Conclusions

A theoretical setting has been sketched in order to justify the adoption of a program of quality administration modeled in ISO 9000 Norm in the context of an university institution of engineering. We believe that this setting is valid and functional at least in the present current moment of the Argentine university system of engineering teaching.

It has not been deepened in all the component elements of the system proposed in reason that the Norm itself has a high degree of universality which permits its application in a distinct degree to each institutional reality.

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The experience of implementing this system is being carried out at the moment in the faculty that motivates this study. The development is still premature in order to be evaluated in the effective impacts of this institutional strategy.

However we can say that among the favorable results of the experience the following symptoms have already been documented:

Involvement and participation of authorities, teachers and students.

Institutional administrative and managerial ordering.

Reduction of costs of perfectly quantifying non-quality.

Simplification of the basic processes as for formulation of investigation and teaching projects.

Surveying objective of weakness and non conformities.

Organizing setting and change institutionalizing.

This program doesn't pretend to be an exporting model for the problems of self-evaluation and evaluation and crediting of higher level education that the several systems and national legislations demand.

We only say that a program like the one here exposed allows to systematize and order teaching and management processes in complex educational institutions.

Thus objetive conditions can be generated in order to pass from a certain handmade state of the art of the educational quality evaluation, to a stadium that don't even pretend to reach scientific sufficiency, at least it meets pre-scientific requirements that the analysis of the educational administration of quality should complete.

Lastly, if we remember that this experience is developed in the context of a faculty of engineering, whose work influences directly on the technological innovation and the industrial managing development, we will see that we are in face of a modality that allows to unify approaches in order to overcome the abyss that in our country has always separated University from Enterprise.

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